The high turbidity reduced mortality of coral bleaching in Kabira Bay, Ishigaki Island

*Kotaro Yashiro[1], Koichi Kinjo[2], Yoshiyuki Nakamura[3]

1. Department of Urban Innovation, Yokohama National Univ. / Tokyo Kyuei Co., Ltd., 2. Okinawa Prefectural Institute of Health and Environment, 3. Institute of Urban Innovation, Yokohama National Univ.

Kabira Bay have 1.5 km in length and 0.5-1.0 km wide, it is located in the northwestern part of Ishigaki Island, Okinawa. The bay mouth is almost closed by several islets, and the bay is connected to the open sea by narrow channels. The inside of the bay is calm and bottom sediment of bay inner part is much silt. Recently, transparency decrease and coral decline are indicated by local inhabitants.
We investigated the present conditions of coral community in Kabira Bay from 2012 to 2013. In the late 1970s, branch-formed and bottle wash brush-formed Acroporidae were dominant species of the east side of the bay (Horikoshi 1979), those most corals died and became coral gravels. However, those corals survived only 2-6 m depth of the bay inner part.
We considered a factor of coral death by several data sets (water temperature, aerial photograph, coral monitoring data of adjacent area, local information) and concluded that it would probably depend on coral bleaching in 2007. Then corals did not die by some kind of factor in the bay inner part.
Water temperature of the bay inner part exceeded 30˚C in July, and decreased approximately 2˚C by torrential rains, and returned to the high temperature a few days later. If there was not the torrential rain, the remarkable water temperature decline was uncommon. We observed water temperature consecutively from 27 August to 30 September in 2013 (largest amount of rainfall was 15mm/day). In 5 m depth, the bay central part and the inner part did not have difference, at 28.7±0.7˚C (mean ±SD) and 28.7±0.8˚C each. Consequently, it is thought that frequent torrential rains were the only requirement for water temperature decline in the bay inner part. During coral bleaching of 2007, the torrential rain was observed only 1 time (60 mm/day), and the possibility that a remarkable water temperature decline got up continuously in the bay inner part is very low. Therefore, coral survival was caused by a factor except the reduction of the high water temperature.
Goreau et al. (2000) reported lower bleaching mortality in very turbid waters in large-scale coral bleaching of 1998. Protection from solar radiation can often occur through scattering by suspended-sediment (SS).
We observed turbidity consecutively from 27 August to 30 September in 2013. Turbidity of bay inner part was the highest in all observed layer. About the solar radiation of 5 m depth, bay inner part was lower than central part, and the value was 2.7% of surface and 6.5%, so reducing the solar radiation by the high turbidity was seen. In addition, the turbidity of the bay inner part had tendency to increase at low tide in the daytime. It is thought that this phenomenon was resuspension of sediment caused by the wind and waves or was transportation as SS such as the red soil which deposited on tidal flats. As the low tide in the daytime is the strongest condition of solar radiation, the effect of the reducing is higher.
On the other hand, turbidity induce the inhibition like a bleaching of Acroporidae when SS reach 10-20 mg/l (Erftemeijer et al. 2012), and mean SS value of the bay inner part was 2.3 mg/l. Consequently, the turbidity condition of the bay inner part was in the range where solar radiation reducing did occur and inhibition did not occur.
Inflows such as the red soils in the bay inner part increased recently, as a result, it is thought that coral mortality was decline. Corals may be protected from bleaching if the turbidity condition was controlled as suitable for corals by the adjustment of inflows such as the red soils.

References
Erftemeijer et al. (2012) Mar. Pollut. Bull. 64, 1737-1765
Goreau et al. (2000) Conserv. Biol. 14, 5-15
Horikoshi (1979) Environmental Marine Science 3, Univ. Tokyo Press, Tokyo, 145-169 (in Japanese)

Keywords: Kabira Bay, Acroporidae, Coral bleaching, Turbidity